MORTALITY AND MORBIDITY AMONG FIRE FIGHTERS AND POLICE OFFICERS IN AN ONTARIO CITY

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Abstract

A mortality study and survey of current health were carried out among members of the Kitchener Fire Department and Waterloo Regional Police Department following concerns raised by a cancer cluster among men who had attended a fire at a manufacturing facility. Mortality rates among members of the 2 forces were similar, and were less than the Provincial average. Cancer mortality rates were similar to the Provincial average, and were comparable between the 2 forces. The health survey found that officers in attendance at the Index fire described more health problems than did other officers. It was concluded that the most likely explanation is that these were related to stress arising from the widespread publicity around the cancer cluster. Otherwise, it was found that the health profile of active members of the police and fire departments was similar.

Introduction

On March 6, 1987 fire fighters from the Kitchener, Ontario Fire Department were dispatched to a fire at a plant that manufactured products for the greenhouse and flower industries. The factory contained a wide variety of materials including foams, inks, dyes, adhesives, and aerosol paints. Over several shifts, 71 fire fighters were involved in fire fighting, overhaul, and salvage operations. In addition, 19 police officers were called to the scene to perform such duties as traffic control.

In the 3 years following the fire, 2 fire fighters who had been in attendance died of cancer, and another fire fighter and a police officer were diagnosed with cancer. The men became concerned that exposures at the fire scene were responsible for the tumours. They were advised that the short latency made it unlikely that there was a causal relationship, but anxiety persisted, fanned by substantial media attention. It was thus agreed that the Ministry of Labour would carry out an investigation of the health experience in the 2 Departments, with particular attention to events following the chemical fire (the Index Fire) which was the focus of the concerns. The study was carried out in 2 phases. The first phase examined the mortality experience of the Fire and Police Departments, and the second was a survey of the health status of members of the 2 forces some 4 years after the Index fire. This report presents the findings of the investigations.

METHODS

1) The Mortality Study

The Study Population

The study roll consisted of all officers on staff of the fire or police departments any time after January 1, 1973, the date on which local police forces were amalgamated into a Regional force. A computerized roll of police officers was available from that date. The roll of fire fighters was manually assembled from Departmental records. The cohort consisted of 227 fire fighters, of whom 179 were current employees and 48 were no longer members of the force, and 706 police officers, of whom 465 were current employees and 241 were no longer members of the force.

Follow-Up and Determination of Causes of Death

The Departments reported which men were currently active or were pensioners, and identified some former employees as being deceased. Additional follow-up was undertaken at the Provincial Driver Licence Registry and at the Canadian Mortality Database. At the end of tracing, all fire fighters were accounted for. The 17 police officers with undocumented vital status were presumed to be alive on December 31, 1987, the latest date at which the Canadian Mortality Database was complete for searching purposes, and were withdrawn from the statistical analysis with vital status "Alive" on that date.

2) The Morbidity Survey

The Survey Form

A survey form, covering major areas of health and reproductive history, was prepared in consultation with the Steering Committee of Fire Fighters and Police Officers. The survey was distributed to the active membership, plus former members who had been in attendance at the Index fire. The replies form a "snapshot" of the health of active members of the Police and Fire Departments as of the Winter/Spring of 1991, some 4 years after the Index fire.

Response Rate:

Replies were received from 121 (68%) of the 179 Fire fighters and 345 (74%) of the 465 Police officers. These included 51 (75%) of the 68 surviving fire fighters in attendance at the Index fire and 15 (83%) of the 18 surviving police officers.

Methods of Statistical Analysis

Mortality Study

Each man was followed from his date of hire or January 1, 1973, whichever came later. Follow-up ended on the date of death, the date a man was withdrawn "Alive" as a result of the Driver Licence or Mortality Database searches, or December 31, 1990 for those men still living. Each year of follow-up was categorized by age and date (in 5-year intervals), and length of time since hire. The official death certificate codes were used to classify the deaths by cause. The "PERSON YEARS" computer program[1] was used to compute Standardized Mortality Ratios, using the general population of Ontario as the reference population.

Point and interval estimates of the relative risk of death for fire fighters compared to police officers were computed by the exact methods described in Breslow and Day[2].

Morbidity Survey

Odds Ratios (Relative Risks) and 95% Confidence Limits were calculated from exact analysis of age-stratified 2x2 Tables and by Multiple Logistic Regression analysis using the Egret computer program[3].

RESULTS

A. MORTALITY

Table 1 shows the results of the comparisons of the mortality of the fire fighters and police officers with Ontario general population rates during the time period January 1, 1973 to December 31, 1990. During the period of observation, overall mortality rates among officers in both Departments were substantially less than expected (1-tailed $P < 0.05$), a pattern in keeping with the "healthy worker effect". Mortality rates from cancer were close to the Provincial average. Among fire fighters, mortality from circulatory and respiratory diseases was substantially less than expected. Among police officers mortality rates from circulatory disease were close to the Provincial average; low mortality in the period up to 30 years from hire was offset by above average mortality in the period 30 or more years after hire. A similar pattern has been observed among Buffalo police officers[4]. Deaths from violent causes were less than expected in both Departments, although 1 fire fighter died in a house fire.

It was noted that 2 police officers died from brain cancer, a rate about 5 times higher than expected. There has recently been some concern that radar emissions might be associated with an increased risk of brain cancer[5], and this possibility was investigated here. Each man who died of brain cancer was randomly matched with 5 other officers who were born in the same year and who were alive at the time of death of the brain cancer victim. The list of 12 names was sent to knowledgeable officers in the Police department for assessment of potential exposure to radar units. It was determined that *none* of the 12 officers had worked with radar units. It is thus concluded that exposure to radar emissions was not a factor in these brain cancer deaths.

Table 2 compares the mortality of the fire fighters with that of the police officers. Over the time period 1973 to 1990 the fire fighters had a lower mortality rate, but none of the differences are statistically significant, and the confidence intervals are very wide.

Table 3 shows that in the period after the Index fire, mortality among the men present was higher than expected because of the cancer deaths which initiated this investigation. In addition, one police officer died of cancer, a rate substantially higher than expected. Among men not present at the Index fire, mortality continued to be less than the Provincial average.

Information about the diagnoses of the cancer victims was obtained from medical records. Physicians were unable to classify one man's tumour prior to his death and postmortem examination was not performed. In a second case, the pathologist found a widespread, poorly differentiated carcinoma of unknown primary at autopsy. Specimens were sent to the Canadian Tumour Reference Centre for review. Three panellists agreed that the tumour was a poorly differentiated carcinoma of unknown primary. Three other panellists expressed the opinion that the tumour morphology was consistent with a primary hepatocellular cancer. In the third case, postmortem examination determined the cause of death to be primary carcinoma of the liver. The cause of death of the police officer was different from any of the above.

B. Current Health Status

Two sets of comparisons were made; a comparison of the health problems reported by police officers and fire fighters, and a comparison of the complaints expressed by the men in attendance at the Index Fire compared to the men not in attendance. Age and smoking habit were confounders in most comparisons. It will be seen later that men in attendance at the Index fire generally described more health problems than other officers. Since the majority of officers at the fire were fire fighters, attendance at the Index Fire confounded the comparison of fire fighters and police officers. The Relative Risks presented in the Tables below are the results of Multiple Logistic Regression models that have been adjusted for the effects of age, smoking, and attendance at the Index fire.

B1. POLICE OFFICERS VS FIREFIGHTERS

1. Marital Status

Six percent of fire fighters were divorced, compared to 8% of police officers. After adjustment for age differences between the 2 forces, it was found that Police Officers were almost twice as likely to be divorced as Fire Fighters, but the difference was not statistically significant (Odds Ratio = 1.96; P = 0.17).

2. Complaints by Organ System

A comparison of problems reported by police officers and fire fighters is presented in Table 4.

a. Skin

Police officers reported fewer problems with their skin than did fire fighters. None of the differences were statistically significant.

b. Sensory Organs

Fire fighters more frequently reported eye irritation and nasal stuffiness. Complaints of hearing problems and ringing in the ears were strongly age dependent. When age was taken into account, police officers were at slightly higher risk of hearing problems.

c. Nervous System

Headache at least once per week was more frequently reported by police officers than by fire fighters, and by officers present at the Index fire in comparison to those not present. In a multivariable analysis, headache was also associated with age and cigarette smoking. Dizzy spells, unsteadiness, tremor, and numbness were reported more frequently by fire fighters than by police officers, and by officers present at the Index fire in comparison to

those not present. In multivariable analyses, dizziness, tremor, and numbness were also associated with age and cigarette smoking.

d. Respiratory System

Chronic cough was more often reported by fire fighters and by men at the Index fire. The most important risk factor for cough was cigarette smoking. Eighteen percent of police officers were current smokers, as were 16% of fire fighters. Smokers were 10 times more likely to report this symptom. Men at the Index fire were about 3 times more likely to report chronic cough. After adjustment for smoking, asthma, and attendance at the Index fire, there was little difference between fire fighters and police officers with respect to the likelihood of chronic cough.

Daily phlegm production was more often reported by police officers and by men at the Index fire. The most important risk factor for daily phlegm production was cigarette smoking. Men at the Index fire were about 3 times more likely to report daily phlegm production. After adjustment for smoking, asthma, and attendance at the Index fire, police officers were about twice as likely to report daily phlegm as were fire fighters.

Chronic Obstructive Pulmonary Disease (COPD) was defined as daily cough and sputum production for 3 months or more during the year. COPD was relatively uncommon, affecting 4 fire fighters and 8 police officers. In a multivariable model for COPD, smoking was the most important risk factor. After adjustment for smoking, police officers and men in attendance at the Index fire were at higher risk of COPD, but the number of affected individuals is small and these differences are not statistically significant.

Four fire fighters and 17 police officers complained of asthma. The Relative Risk of asthma for police officers in comparison to fire fighters was 1.61 [95% Confidence Interval: 0.5 - 6.7].

e. Cardiovascular System

Three police officers, but no fire fighters, reported angina as a current problem. It is conceivable that police officers who develop angina might remain at work while fire fighters would have to take disability leave; it was not possible to determine if that was a factor here. After adjustment for attendance at the Index fire, police officers were also more likely than fire fighters to have received treatment for high blood pressure in the previous 3 years.

f. Gastrointestinal System

Fifteen men described stomach ulcers or gastritis, and irritable bowel or colitis was described by 8 men. Bowel disorders were more common among men who had been in attendance at the Index fire.

h. Joints and Back

Joint and back problems were reported frequently by men in both forces. Fire fighters generally experienced more difficulties with their joints than did police officers. Forty-two (33%) fire fighters complained of joint problems, compared to 75 (22%) police officers. The probability of joint problems increased with age, and when age was accounted for, the Odds Ratio for a joint problem was 0.8 [95% Confidence Interval: 0.5 - 1.4] for police officers compared to fire fighters. There was no significant association with length of employment on the force. Men at the Index fire more frequently described a problem with joint pain. [Relative Risk = 1.7; 95% Confidence Interval 0.9 - 3.1]. Thirty-six percent of the population of fire fighters and police officers complained of a problem with back pain. The complaint was more common among fire fighters (42% of 129 men) than among police officers (33% of 346 men). The prevalence increased from 13% among men 19 to 28 years of age to 47% among men 49 to 59 years of age. After controlling for the effect of age, the number of years employed as a police officer or fire fighter was strongly associated with the

complaint of back problems. Current smokers were significantly more likely to complain of back problems than were non-smokers (Odds Ratio = 1.8). Men in attendance at the Index fire were more likely to report back problems. After accounting for attendance at the Index fire, police officers were at lower risk of back problems (Odds Ratio = 0.9) but the difference between the forces was not statistically significant.

i. Reproductive Outcomes

1) Miscarriage or Stillbirth.

Officers were asked whether they had ever fathered a pregnancy that ended in miscarriage or stillbirth while employed as a fire fighter or police officer. Analysis of the responses was limited to the 405 officers who reported having been married. Miscarriage was reported in the partners of 12 (10%) of 120 fire fighters and 39 (13.7%) of 285 police officers. Adjusted for age, the risk of miscarriage among the partners of police officers was 1.38 [95% Confidence Limits: 0.6 - 3.1] in comparison to the partners of fire fighters.

2) Physical or mental problems in the offspring

Fourteen physical (5.2%) and one mental developmental problem were listed among the 266 children of fire fighters. Twenty eight (5.1%) physical and 8 (1%) mental developmental problems were listed among the 552 children of police officers. There was no clustering of any disorder and no evidence of increased problems among the offspring of fire fighters. One fire fighter reported the birth of a child with Down's syndrome about 16 months after the Index fire. The mother was older than 35 years of age at the time of the birth of her child and it is known that the incidence of Down's syndrome rises dramatically in older mothers. It is not possible to assess what additional role paternal occupational exposures might have played.

B2. Health Problems in Relation to Attendance at the Index Fire

Table 5 shows the distribution of current health complaints in relation to attendance at the Index fire 4 years previously. It can be seen that officers who had been in attendance at the fire described more problems with their health than did officers who had not been present at the Index fire.

C. Smoking and Health

Table 6 compares the health problems reported by current smokers to those reported by non-smoking officers. It can be seen that smokers were more likely to report problems with a wide variety of organ systems.

Discussion

This investigation was carried out because of a putative cluster of cancer deaths among fire fighters and police officers who attended a fire at a manufacturing facility in March, 1987. The results indicate that in the period 1973 to 1990, the fire fighters and police officers had a better than average mortality experience. This finding is to be expected, since passing a test of physical fitness is required in order to join the forces. Although cancer mortality rates were about the same as the Ontario average during this same period, and were similar for members of both forces, the occurrence of a cancer cluster after the Index fire was confirmed.

Mortality risk among fire fighters, particularly the risk of cancer, cardiovascular and respiratory diseases, has been the subject of increasing interest in recent years. It is known that fire fighters may be exposed to toxic chemicals in the course of fighting ordinary house fires. For example, in a study in Buffalo[6] it was found that fire fighters were frequently exposed to chemicals including carbon monoxide, benzene, sulphur dioxide, hydrogen cyanide, aldehydes, hydrogen chloride, and dichlorofluoromethane as well as to particulates. Furthermore, in many cases of the heaviest exposure to these materials respiratory protective equipment was not used because of the visual impression of low smoke intensity. Howe and Burch[7] have recently reviewed the epidemiologic literature to assess the risk of cancer among fire fighters. They reviewed cohort studies from Australia[8], Boston[9], Buffalo[10], the Northwest US[11], and Toronto[12]; and proportionate mortality studies from British Columbia[13], California[14], New Jersey[15], and Washington State[16]. They concluded that the combined information from these studies provided no evidence of any increase in risk of cancer in general or of lung and colon cancer in particular. They did, however, find positive associations with brain tumours, malignant melanoma, and multiple myeloma, but it was not clear whether these associations were causal in nature.

There is little published data about mortality risk among police officers. Rosenstock and colleagues[17] used police officers as a comparison population for fire fighters in the Northwestern United States and found that their mortality rates were significantly lower than

that of the United States population. In a PMR study, Feuer and Rosenman[15] found no differences from the New Jersey general population in causes of death. Vena and colleagues[4] studied the mortality experience of police officers in Buffalo and found an overall SMR of 106 and significantly elevated cancer mortality (SMR = 127).

This analysis has confirmed that men in attendance at the Index fire had a substantially higher cancer risk than was observed either before the fire or among men who were not in attendance at the fire. A major concern of the men at the fire was exposure to the chemicals stored at the plant. The Fire Department established that much of the chemical inventory was in storage locations where it was not damaged by the blaze. It was determined that the materials that were involved in the fire were several drums of Freon 11, less than 1 drum of phenolsulfonic acid, 7 drums of surfactant, and a large amount of the finished product, a foam called Oasis.

Assessment of the hazard posed to fire fighters by these compounds is difficult because there is no measure of exposure of the officers to any of these compounds or to their thermal decomposition or combustion products, some of which may be substantially more toxic than the original compounds. Freon 11, for example, is used as a foaming agent. It has very low toxicity, but in contact with flame it may be converted to phosgene gas, a severe respiratory irritant, which can lead to death by respiratory failure. Freon 11 has been tested for carcinogenicity in rats and mice, and has been negative in both species. Phenolsulfonic acid is used in the manufacture of foams. There is little information about its toxicology. Poisonous vapours are produced in fire, and its decomposition products include phenol vapours, oxides of sulphur, as well as carbon monoxide and carbon dioxide. Phenol is a potent irritant, but is not a recognized carcinogen. Sulphur oxides are also respiratory irritants, but are not recognized carcinogens.

The surfactant mixture contained sodium salts of organic acids plus organic esters in additional to isopropyl alcohol. Oxides of sulphur, as well as carbon monoxide and carbon dioxide may be present in the combustion products. Organic esters are not recognized as carcinogenic substances. The decomposition products of the Oasis foam may include phenol, formaldehyde, acrolein, and carbon monoxide. Formaldehyde is capable of inducing nasal cancers in experimental animals and is a suspect carcinogen of the human respiratory tract.

Acrolein may cause severe irritation of the eyes and lungs. It is not a recognized human carcinogen.

Within a few days of the Index fire, many of the fire fighters in attendance completed an "Exposure Report Form" which had been designed by the Health and Safety Committee of the Fire Fighters Association. This form contained questions about activities at the fire scene, smoke conditions, symptoms such as cough and rash experienced at the scene or later, special equipment and decontamination procedures, co-workers at the time of exposure, and personal habits such as cigarette smoking. These Exposure Report Forms were used in "case-control" analyses to attempt to identify any fire-related factors which might be associated with the development of cancer following the fire.

Fifty six (including 2 cancer victims) of the 71 men who had been at the fire completed reports. Since respondents indicated with whom they had been working it was possible to infer activities for an additional 12 men (including 1 cancer victim) by assuming that they had performed the same duties as the men they had worked with closely. Data was thus available for 68 of the 71 men for fire-related questions, but was available for only 56 of the 71 for personal questions, such as symptoms experienced after the fire.

Variables examined in the case-control analysis included Stage of Fire during attendance (Early Stage, Free Burning, Smouldering), Activity During Attendance (Extinguishment, Light Overhaul, Heavy Overhaul), Physical symptoms (burning eyes, cough, nose/lung irritation, nausea, dizziness, headache, skin irritation, or other), visit to a physician, and smoking habit.

There was no association between Stage of Fire during attendance and the risk of cancer death. With respect to fire fighting activities, 3 of 38 men who were involved in overhaul operations developed cancer, while none of the 30 men who were not involved in overhaul operations died from cancer. Men performing overhaul operations are potentially exposed to fumes from smouldering debris. It was also found that men who reported irritative symptoms compatible with substantial smoke exposure, such as burning eyes, cough, or nose/lung irritation, had a higher risk of developing cancer than men who did not report these symptoms. On the other hand, a number of men *who did not develop cancer* reported symptoms that the cancer victims did not report. These included nausea, dizziness,

headache, and skin irritation. Because of the small numbers involved, none of the differences in the case-control comparisons were statistically significant.

There are 3 plausible explanations for the cancer cluster which should be considered here: 1) these deaths were related to occupational exposures occurring prior to the fire which served only to draw attention to cancer risk among fire fighters;

2) these deaths were caused or accelerated by exposures received at the fire; 3) these deaths were unrelated to occupational exposures and their apparent relation to the fire is coincidental.

Could these cancer deaths be attributable to earlier exposures? Table 7 reviews the results of cancer studies in 8 other jurisdictions. Some of the studies found risks slightly higher than average, while others found risks slightly lower than average. Combining the results of all of them we find that fire fighters have had the same risk of death from cancer as the general population of their jurisdictions. The fire fighters in this study, have had an experience consistent with this pattern. It is thus concluded that the cancers occurring after the Index fire are not likely attributable to exposures occurring earlier in the fire fighters' careers.

Could these deaths be attributable to exposures at the Index fire? It was not possible to determine with assurance the pathology of the tumours. One of the deaths was due to primary hepatocellular carcinoma. In a second case there was no agreement among pathology consultants, but primary hepatocellular carcinoma was considered to be a possibility. Hepatocellular carcinoma is a relatively rare tumour, and the liver is the site of detoxification of many organic chemicals, so that the possibility of occupational causation must be considered. We found that men involved in overhaul operations at the fire had a higher risk of cancer than men not so involved, and that men who reported certain irritative symptoms had a higher risk of cancer, but these differences were compatible with chance. The major arguments against there being a causal connection are the short latency and the probability that chemical exposures, although unmeasured, were low in comparison to those which have occurred in industrial settings where it commonly took years of exposure before cancer risk was measurably increased. It is concluded that it is not possible to convincingly

confirm or refute the possibility that unmeasured chemical exposures at the Index fire were in some way responsible for the cancer deaths occurring among the men in attendance at the fire.

The second phase of the study was a survey of current health some 4 years after the Index fire. Although management and the Officers' Associations supported the survey and encouraged their members to participate, response was far from complete, being 68% for fire fighters and 74% among police officers. The possibility that the results are distorted by Response Bias is thus present.

The major concern at the start of the investigation was that the health of men in attendance at the Index fire might have been affected by the experience. Table 5 showed that officers present at the fire generally described more health problems than did men who were not present at the Index fire. Four years after the Index fire, men in attendance more often reported problems with skin and eye irritation; nervous system complaints including headache, dizziness, and numbness; respiratory complaints including chronic cough and sputum production; were more likely to have been treated for high blood pressure within the previous 3 years; more often reported irritable bowel symptoms; and more often reported joint problems and back pain.

As discussed above, respiratory, skin, and eye irritants were present at the fire scene, in addition to the "usual" products of combustion. It is difficult to assess whether, despite personal protective equipment, exposure to these substances would have been great enough to produce health complaints as long as 4 years after the Index fire. The most straightforward explanation for the increased occurrence of these problems among men who attended a fire 4 years previously, and the one that accounts for most of the problems described by men at the Index fire, is that these problems are stress-related. Because of the extensive publicity surrounding the cancer cluster that occurred among men present at the Index fire, it is quite likely that other men present at the fire would experience a high level of anxiety and stress. Skin irritation, headaches, numbness, shakiness, irritable bowel syndrome, and back ache are commonly reported by persons experiencing increased levels of stress. It is also plausible that increased anxiety would lead to the diagnosis and treatment of high blood pressure. An alternative explanation is Reporting Bias, the tendency for survey subjects who have

experienced the exposure of concern to more often report symptoms than subjects who did not experience the exposure. In the present instance, Reporting Bias would be difficult to separate from the effect of stress.

Since the survey population included both fire fighters and police officers, it was possible to compare the health status of the 2 forces. Table 4 compared the health problems reported by Fire Fighters to those reported by Police Officers. It can be seen that some problems were reported more frequently by Police officers and some more frequently by Fire fighters. None of the differences were statistically significant. It is concluded that there were no substantial differences between the average health profiles of active Police Officers and Fire Fighters.

CONCLUSIONS

This paper presented the results of a study of mortality and a survey of current health in a cohort of municipal fire fighters and police officers. Mortality rates among members of the 2 forces were similar. Overall mortality rates were less than the Provincial average, in keeping with the "healthy worker effect". Cancer mortality rates were similar to the Provincial average, and were comparable between the 2 forces. A cluster of cancer deaths occurred among officers who had been in attendance at a fire at a manufacturing facility in 1987, but it is not possible to provide a definitive explanation. A survey of health some 4 years after the Index fire found that officers in attendance described more health problems than did other officers. It was concluded that the most likely explanation is that these were related to stress arising from the widespread publicity around the cancer cluster. Otherwise, it was found that the health profile of active members of the police and fire departments was similar.

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TABLE 1: MORTALITY FOR FIRE FIGHTERS AND POLICE OFFICERS COMPARED TO PROVINCIAL AVERAGE
MEN ON STAFF JANUARY 1, 1973 OR LATER FOLLOWED TO DECEMBER 31, 1990

CAUSE OF DEATH	FORCE	YEARS SINCE HIRE														
		0 - 9			10 - 19			20 - 29			30 or More			TOTAL		
		OBS	EXP	O/E	OBS	EXP	O/E	OBS	EXP	O/E	OBS	EXP	O/E	OBS	EXP	O/E
ALL CAUSES	F	1	2.81	0.36	1	4.38	0.23	6	6.26	0.96	3	5.15	0.58	11	18.6	0.59
	P	2	5.73	0.35	2	7.43	0.27	2	8.63	0.23	17	11.0	1.54	23	32.8	0.70
ALL MALIGNANCIES	F	1	0.33	3.06	0	0.84	0	3	1.78	1.69	1	1.68	0.59	5	4.63	1.08
	P	1	0.70	1.44	0	1.50	0	1	2.39	0.42	5	3.48	1.44	7	8.07	0.87
DIGESTIVE CANCER ICD:150-159	F	0	0.06	0	0	0.24	0	2	0.52	3.85	0	0.49	0	2	1.32	1.52
	P	0	0.14	0	0	0.41	0	0	0.70	0	0	1.03	0	0	2.28	0
RESPIRATORY CANCER ICD:160-165	F	0	0.03	0	0	0.22	0	0	0.68	0	1	0.68	1.47	1	1.62	0.62
	P	0	0.11	0	0	0.38	0	0	0.89	0	1	1.39	0.72	1	2.77	0.36
BRAIN CANCER ICD:1910-1919	F	0	0.04	0	0	0.07	0	0	0.09	0	0	0.05	0	0	0.24	0
	P	0	0.07	0	0	0.12	0	0	0.12	0	2	0.10	20	2	0.41	4.93
CIRCULATORY DISEASE ICD:3900-4599	F	0	0.40	0	0	1.50	0	1	2.67	0.37	1	2.37	0.42	2	6.93	0.29
	P	0	0.76	0	0	2.18	0	1	3.66	0.27	10	5.14	1.95	11	11.7	0.94
ISCHEMIC HEART DISEASE ICD:4100-4149	F	0	0.24	0	0	1.16	0	1	2.12	0.47	1	1.79	0.56	2	5.32	0.38
	P	0	0.48	0	0	1.64	0	0	2.90	0	7	3.87	1.84	7	8.88	0.79
RESPIRATORY DISEASE ICD:4600-5199	F	0	0.07	0	0	0.12	0	0	0.20	0	0	0.28	0	0	0.67	0
	P	0	0.12	0	0	0.19	0	0	0.29	0	0	0.63	0	0	1.23	0
VIOLENT CAUSES ICD:8000-9999	F	0	1.64	0	1	1.23	0.81	2	0.72	2.76	0	0.22	0	3	3.82	0.79
	P	1	3.49	0.29	2	2.39	0.84	0	1.07	0	0	0.48	0	3	7.43	0.40

Notes: OBS = Number of deaths that occurred; EXP = Expected Number of Deaths Based Upon Ontario Average; O/E = Ratio of Observed to Expected
In the TOTAL Column, the ALL CAUSE SMRs are significantly less than 100 (1-tailed P < 0.05); none of the other ratios are significantly different from 1.0 (2-Tailed P > 0.05 for all)

Table 2: Mortality Among Fire fighters Compared to Police Officers			
Cause of Death	Risk for Fire fighters Compared to Police Officers	Lower 95% Confidence Interval	Upper 95% Confidence Interval
All Causes	0.84	0.33	1.81
All Malignancies	1.24	0.30	4.56
Ischemic Heart Disease	0.48	0.05	6.17
Violent Causes	1.95	0.23	14.3

Table 3: Mortality Among Fire fighters at Index Fire Compared with Mortality Prior to Fire and Compared with Mortality of Men Not at Fire

Cause of Death	Risk for Fire fighters at Fire *Compared with Time Period Prior to Fire*	Lower 95% Confidence Interval[1]	Upper 95% Confidence Interval[1]
All Causes	6.46	1.39	29.9
All Malignancies	29.8	0.36	1564
	Risk for Fire fighters at Fire *Compared with Risk for Men not at Fire*[2]		
All Causes	6.16	0.41	73
All Malignancies	13.5	0.17	709
	Risk for Fire fighters *Not at Fire*[2] *Compared with Time Period Prior to Fire*		
All Causes	1.04	0.22	5.81

NOTES: 1) Confidence Limits calculated by exact method based upon ratio of 2 SMRs.
2) Group of men not at fire includes fire fighters who had left force prior to March, 1987.

Table 4: A Comparison of Problems Reported by Fire Fighters and Police Officers

PROBLEM	RISK AMONG POLICE OFFICERS IN COMPARISON TO FIRE FIGHTERS*	
	Relative Risk	95% Confidence Interval
DIVORCE	1.96 (8% vs 6%)	0.8 - 5.4
SKIN		
Acne	0.7 (15% vs 21%)	0.3 - 1.6
Irritation	0.8 (10% vs 13%)	0.4 - 1.6
Rash	0.6 (5% vs 9%)	0.2 - 1.5
Current Medical Treatment of Skin	0.6 (5% vs 9%)	0.2 - 1.6
SENSORY ORGANS		
Eye Irritation	0.7 (7% vs 12%)	0.3 - 1.5
Hearing Problems	1.4 (12% vs 14%)	0.7 - 2.9
Ringing in Ears	0.9 (9% vs 13%)	0.4 - 1.9
Nosebleed	1.1 (10% vs 9%)	0.5 - 2.3
Stuffy Nose	0.6 (20% vs 29%)	0.4 - 1.1
NERVOUS SYSTEM		
Weekly Headaches	2.1 (11% vs 10%)	0.9 - 4.9
Dizzy Spells	1.5 (5% vs 9%)	0.5 - 3.9
Unsteadiness	1.2 (9% vs 13%)	0.3 - 5.4
Tremor or Shakiness	1.0 (2% vs 3%)	0.2 - 5.0
Tingling or Numbness	0.9 (10% vs 14%)	0.4 - 1.9
RESPIRATORY SYSTEM		
Chronic Cough	1.1 (5.5% vs 7%)	0.4 - 3.1
Sputum Production	2.4 (7% vs 6%)	0.9 - 6.6
Chronic Obstructive Pulmonary Disease	1.7 (2% vs 3%)	0.3 - 9.5
Asthma	1.6 (5% vs 3%)	0.5 - 6.7
CARDIOVASCULAR DISEASE		
Angina	3 Police Officers; 0 Fire Fighters	
High Blood Pressure	1.7 (4% vs 8%)	0.6 - 5.0

Continued.....

Table 4: A Comparison of Problems Reported by Fire Fighters and Police Officers

PROBLEM	RISK AMONG POLICE OFFICERS IN COMPARISON TO FIRE FIGHTERS*	
	Relative Risk	95% Confidence Interval
GASTROINTESTINAL PROBLEMS		
Ulcer or Gastritis	1.3 (3% vs 4%)	0.4 - 5.4
Irritable Bowel	0.4 (1.4% vs 2.3%)	0.1 - 2.4
BONES AND JOINTS		
Joint Problems	0.8 (22% vs 33%)	0.5 - 1.4
Back Pain	0.9 (33% vs 42%)	0.5 - 1.3

*The Relative Risks have been adjusted for age, smoking, and attendance at the Index fire. The percentages in parentheses are the crude proportions of officers reporting the problem. A value greater than 1 implies the problem was more common among Police Officers; a value less than 1 indicates that the problem was more common among Fire Fighters.

Table 5: Health Problems in Relation to Attendance at the Index Fire

SYMPTOM	MORE COMMON AMONG MEN AT Index FIRE		ABOUT THE SAME OR LESS COMMON AMONG MEN AT Index FIRE	
	Relative Risk[1]	95% Confidence Interval	Relative Risk[1]	95% Confidence Interval
SKIN				
Acne			0.70 (10% vs 17%)	0.3 - 1.6
Irritation	2.8 (22% vs 9%)	1.3 - 5.6		
Rash	2.1 (9% vs 5%)	0.7 - 5.6		
Current Medical Treatment	2.6 (12% vs 5%)	0.9 - 6.7		
SENSORY ORGANS				
Eye Irritation	1.8 (14% vs 7%)	0.8 - 4.4		
Hearing Problems			0.9 (17% vs 12%)	0.5 - 1.9
Nosebleed			0.7 (8% vs 10%)	0.3 - 1.9
Stuffy Nose			1.2 (30% vs 21%)	0.6 - 2.4
NERVOUS SYSTEM				
Weekly Headaches	3.9 (19% vs 9%)	1.6 - 9.1		
Dizzy Spells	4.4 (16% vs 5%)	1.6 - 11.8		
Unsteadiness	1.6 (4% vs 2%)	0.3 - 7.4		
Tremor or Shakiness	2.3 (4% vs 2%)	0.4 - 12.9		
Tingling or Numbness	1.6 (4% vs 2%)	0.7 - 3.7		
RESPIRATORY SYSTEM				
Chronic Cough	2.8 (9% vs 5%)	0.9 - 9.2		
Sputum Production	3.1 (11% vs 8%)	1.1 - 8.8		
Chronic Obstructive Pulmonary Disease	2.3 (4% vs 2%)	0.4 - 14.2		
CARDIOVASCULAR				
High Blood Pressure	3.1 (12% vs 4%)	1.1 - 9.0		
GASTROINTESTINAL PROBLEMS				
Ulcer or Gastritis			0.6 (3% vs 3%)	0.1 - 2.9
Irritable Bowel	2.3 (4% vs 1%)	0.4 - 13		

[1]Adjusted for age and smoking habit.

Table 6: Problems Reported by Current Smokers in Comparison with non-Smokers		
PROBLEM	RISK AMONG CURRENT SMOKERS IN COMPARISON TO NON-SMOKERS	
	Relative Risk	95% Confidence Interval
SKIN		
Irritation	1.6	0.8 - 3.1
Rash	1.3	0.5 - 3.3
Current Medical Treatment	2.1	0.9 - 4.9
SENSORY ORGANS		
Eye Irritation	1.9	0.9 - 3.9
Hearing Problems	1.5	0.8 - 2.8
Ringing in Ears	1.6	0.8 - 3.1
Stuffy Nose	3.2	1.9 - 5.3
NERVOUS SYSTEM		
Weekly Headaches	2.7	1.4 - 5.3
Dizzy Spells	2.9	1.3 - 6.6
Unsteadiness	2.1	0.6 - 7.3
Tremor or Shakiness	7.3	2.2 - 23.9
Tingling or Numbness	2.3	1.2 - 4.5
RESPIRATORY SYSTEM		
Chronic Cough	9.5	4.1 - 21.8
Sputum Production	6.6	3.2 - 13.3
Chronic Obstructive Pulmonary Disease	9.4	2.7 - 33.1
GASTROINTESTINAL PROBLEMS		
Ulcer or Gastritis	2.3	0.8 - 7.0
Irritable Bowel	3.0	0.7 - 13.1
BONES AND JOINTS		
Joint Problems	1.7	1.0 - 2.9
Back Pain	1.9	1.1 - 3.0

Table 7: Cancer Risk Observed in Various Cohorts of Fire Fighters

Fire Department	Number of Fire Fighters	Years Employed	Years of Follow-Up	SMR	95% Confidence Interval
Boston[9]	5655	< 1915 - 1975	1915 - 1975	86	77 - 95
Buffalo[10]	1867	< 1950 - 1979	1950 - 1979	109	88 - 132
Denmark[18]	886	< 1971	1970 - 1980	117	72 - 178
Edmonton and Calgary[19]	3328	< 1927 - 1987	1927 - 1987	126	102 - 155
San Francisco[20]	3066	< 1940 - 1970	1940 - 1982	95	84 - 108
Seattle[11]	2289	< 1945 - 1980	1945 - 1983	96	77 - 118
Toronto[21]	5414	< 1910 - 1989	1950 - 1989	105	90 - 120
Western Australia[8]	990	< 1939 - 1978	1939 - 1978	109	74 - 156
TOTAL				97	91 - 103
Fire Fighters This Study	227	< 1973 - 1990	1973 - 1990	108 (5 / 4.63)	35 - 252
Police This Study	706	< 1973 - 1990	1973 - 1990	87 (7 / 8.07)	35 - 178